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ABSTRACT

Teachers recognize that students may successfully perform diverse actions and not understand what they have done. Several classroom techniques are employed to increase students' comprehension, such as giving more time to practice and accepting students' "growth" errors. In order to understand, children must be given the opportunity to construct their own understanding, even though a mismatch may occur between their representations of their thinking and conventional symbols. A true representation, though, reflects what a child is thinking at a certain time, not what adults think the child should be thinking. Gaining understanding involves reflexive abstraction: a projection of experiences to a higher level and a reorganization of experience at that higher level. For example, children who successfully build numbers with Dienes Blocks may then project that experience mentally and reorganize it with mathematical symbols to reflect their work. Children's increasingly systematic competence at a task is a clue that they are ready to become conscious of what they are doing. Over time a match between children's symbols and conventional symbols will occur. The developmental teacher is aware of the difference between success and understanding and encourages children to go beyond the right answers to attain understanding of the rules that lead to the right answers. (RH)

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Are We Teaching For Success Or Understanding?

Dr. Doris O. Smith

A few years ago, I had a Teaching Fellow who was both brilliant and dedicated. Frequently, she became very frustrated while presenting a math lesson to our primary children because they couldn't "get it"- that is, they couldn't achieve the right answers with understanding. She would go home and study math textbooks until the morning hours because she was convinced there was something wrong with her teaching. Similarly, honest and observant teachers consistently report that children in their classrooms "get" the right answers on ditto sheets and in workbooks but the teachers know that the children don't really understand what they are doing. These examples remind us that there is a difference between having success and having understanding. Two of Piaget's most recently published books, The Grasp of Consciousness and Success and Understanding discuss the importance of self-awareness in the acquisition of knowledge. These books show that children often succeed in getting desired effects but they cannot go beyond a low level of success when they cannot understand what they are doing. When understanding is achieved the learners become more flexible in their thinking, independent, confident and more able to generalize to new situations (Piaget, 1978).

Success occurs at the level of action, and understanding operates at the level of thought (Gallagher and Reid, 1981). For instance, young children can successfully perform certain tasks like building a house of cards or hitting a target by releasing an object, but they are unable to abstract a rule to explain their success at what they just did (Piaget, 1976).

At another level, college students in my classroom were successful in achieving the correct puzzle solution for the Hanoi Tower Game but found it much more difficult to describe what they did to achieve success. This game is recommended to demonstrate the difference between success and understanding. It is not necessary to have the actual game in the classroom. My college class

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played the game with sketches and with their own invented systems of diagrams or notations for writing out their moves in sequence.

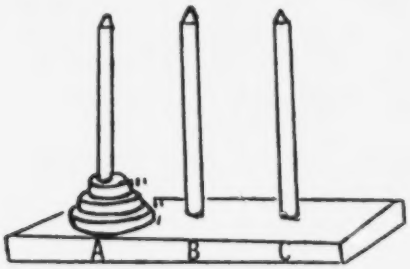

FIGURE 1. The Hanoi Tower. Move discs from A to C according to rules.

Three posts A, B, and C are vertically attached to a baseboard. A graduated set of discs with a hole in the center (largest at bottom to smallest at top) is placed on A, the starting point. The player is told to move the discs from Post A to Post C observing the following rules; 1) only one disc at a time can be moved; 2) no disc may be placed on a smaller one; 3) discs may not be rested on the table; and 4) discs may not be held in hand while another disc is being moved. Success depends on the player's awareness of Post B as an intermediary (storage) post as various moves are made (Gallagher and Reid, P. 119).

As the student teachers were performing the game I observed that they achieved success at various rates. However, it was surprising and informative to note that even those students who were very quick at completing the puzzle found it quite difficult to abstract a rule about what they had just done. In order to get to this level, which we call understanding, the players had to hypothesize, risk, try alternative, practice, make mistakes, check answers, try again and finally, discover a rule. The process of acquiring understanding

comes from real experience, having success and using that success to get at patterns of rules. It is a cognitive struggle.

Similarly, elementary school teachers observe that students may reach success at the level of action regarding place value operations but not at the level of understanding (thought). One teacher described her frustration as follows:

> It doesn't seem to matter whether I start with manipulatives and move to representation (symbolization) or start with representation and supplement with manipulatives. They still cannot do both equally well. They might be able to do place value with manipulatives but when I ask them to write down what they just did they bog down. Or, they might do the mathematical operation with abstract numbers by following the rules for the process but, then, they cannot show with manipulatives what they just did (Bailey, 1983).

It may be as hard for children to get the rule for place value as it is for college students to get the rule for the Hanoi Tower Game. When I ask teachers what they do when children don't get the answers or when they know that the right answers do not represent true understanding, several techniques are frequently mentioned. Usually a teacher will give the students more time to practice. Thus, repetition is a key. Sometimes it helps for children to tell what they are doing as they do it. Also, it helps to encourage children to draw or show graphically what they are doing. Above all, it is important for the teacher to accept errors in the process. These can be called partial success or growth errors and are a very acceptable part of the learning process. One teacher intuitively tells her children to go home and sleep on it. She, then, at a later time reviews their understanding of what they did when they return. Another teacher told me that cross-age

tutoring is useful as well as peer teaching. When children read to others who are not at their level, they go slowly so the younger children can understand but, really, the readers are becoming aware and conscious of what they are doing.

From a developmental perspective, this process can be explained theoretically. Children must be given the opportunity to construct their own understanding. First knowledge is acquired (action) and then conscious control (understanding) of the knowledge is gradually developed (Vygotsky, 1962).

But there also may be a mismatch in the way a child represents his thinking and in the way we want him to represent it. Classroom teachers who are, at the same time, expert researchers about children and learning, realize that the ways we represent mathematical operations in classrooms are socially agreed on systems. However, these systems are not truly the child's inner representations.

> If the intellectual powers are to develop the child must gain control over his own thinking and he cannot control it while he remains unaware of it. Thus, a large part of the teacher's task may be to help children to achieve efficient inner representations of the problem they are expected to tackle. Error can play a highly constructive role in the development of thinking (Donaldson, 1978, p. 110).

Teachers have shared with me and I, too, have observed with amazement how difficult it is for young children to represent what they just did on paper. For instance, in a primary group the children loved to play a bowling game. They actually used a ball and some pins in the classroom. It was clear that they knew how to play the game. When asked to write down on paper what happened it was much more difficult than one would expect. How many pins did you hit? How many fell down? How many are left? It is hard to believe that

the children could not do this automatically. After all, they had just rolled the ball and hit the pins. Now, I realize that I was expecting the children to use a preestablished "system" for representation. I wanted them to write in "I hit 8 pins, 2 pins are left etc. Actually, I should have let them invent their own representations for what they had just done. A true representation should reflect what the child is thinking at a certain time not what we think he should be thinking. Often children choose to use a tally system rather than numerals to represent what they did (one mark for one pin, etc.) Apparently, it is more difficult for children to use numerals than we realize.

At second grade children were very adept at building with Dienes Blocks and with bundles of toothpicks. They could build 26 with two sets of ten and six single units, etc. They could also put two sets together with the manipulatives with great skill and accuracy. Again, when asked to show me on paper what they had just done, there was not a direct transfer. To represent on paper is not a representation of the operation as much as it is a representation of the child's thinking about the operation. The children could do the operation and they were working on the process of understanding what they had done. This is called reflexive abstraction.

The two characteristics of reflexive abstraction are projection to a higher level and reorganization at the higher level (Gallagher, 1978). Children who build numbers with Dienes Blocks then project that experience mentally and reorganize it with mathematical symbols to reflect their work. As children become systematically competent at a task, it is a clue that they are becoming ready to become conscious of what they are doing. This is a slow-down process- an awkward period of figuring things out.

When children write their own math papers they are forced to become aware of the mathematical operations- to reflect. We, the teachers, are allowed to witness where they are in their own thinking. Having children

write math problems for themselves and for each other is a useful technique for promoting understanding at the level of thought.

In a kindergarten workshop, kindergarten teachers discussed the difference in affect between children's use of "key words"- the child's own words- and the teaching of words from a basal series. Because of the strong interest and involvement with their own key words children were more successful at developing word attack skills with these words than with lists from basal series. The children read their own key word by sight, i.e., they have success. then, through using the word in a variety of games, tasks, applications they begin to understand what a word is and what makes it say what it does. By writing and "doing something" with the key word- drawing a picture, building with clay, dramatizing, etc.- they represent it both in their own way and in the way of the formal curriculum. Over time the match between their symbol and the formal symbol will occur.

This is an elegant example of teaching for success and understanding. The children experience success in a meaningful context and they construct their own understanding of words and the word system. Gradually they apply their understanding to how other words and sentences and stories work.

The developmental teacher is aware of two processes occurring at the same time in children. Increasing competence at a skill develops on one level. At the same time, self-awareness of what is happening is developing on another level. The teacher is aware of the difference between success and understanding and encourages children to go beyond the right answers- to understand the rules that lead to the right answers. At the same time the teacher must acknowledge the importance of allowing the children to use their own inner representations to describe their thinking. Gradually they will match their inner representation with formal representational systems (mathematical and reading symbols). In this way the symbol system will have real meaning.

If we know the importance of competence and also the importance of looking at right answers in the perspective of the whole learning process we will provide opportunities for children to learn in meaningful context, to be active in the process, to try new things, to have their own success at the level of action and to build their own understanding at the level of thought. The teacher's role is to let children stop and reflect, to look back on what they just did, to describe what they thought they did, to test their ideas and to try different things. In this way they gain control, understanding, mastery and confidence. Teaching for success and understanding are worthwhile goals because together they develop efficient and independent thinkers.

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